TITLE OF THE INVENTION

DATA TRANSFER METHOD

FIELD OF THE INVENTION

5   The present invention relates to a technique for transferring data by serial communication and rewriting data stored in a nonvolatile memory by the transferred data.

BACKGROUND OF THE INVENTION

10   In recent years, flash ROMs as a kind of nonvolatile memories are becoming popular and replacing ROMs (Read Only Memories) and EPROMs (Electrical Programmable Read Only Memories) as recording media. A

15   flash ROM is a nonvolatile memory that is electrically erasable and writable. Unlike a ROM or EPROM, the flash ROM can rewrite data without exchanging elements. To rewrite data, a method of rewriting a flash ROM by connecting a flash writer or a method of rewriting data

20   by using a dedicated rewrite program is generally used.

         The rewrite method using a dedicated flash ROM rewrite program will be described by using a normal printing apparatus as an example. A normal printing apparatus is constituted by a video controller that

25   converts image information into bitmap data and a printer engine that forms an image on the basis of the pixel data and transfers and fixes the image on a

printing medium. An example of the interface between
the video controller and the printer engine will be
described below.

Fig. 1 is a block diagram showing an interface
5   (to be referred to as a video interface hereinafter)
that connects a video controller 10 and printer engine
20 in a printing apparatus. Fig. 2 is a table showing
a list of video interface signals. Referring to
Fig. 2, "output" indicates output from the printer
10   engine 20 to the video controller 10, and "input"
indicates input from the video controller 10 to the
printer engine 20.

The printer engine 20 includes an engine
controller (CPU 30, RAM 31, and flash ROM 32) that
15   controls the printer engine. The engine controller
exchanges signals between the printer engine 20 and the
video controller 10 and controls the printer engine 20.

A beam detection (/BD) signal shown in Fig. 2 is
a main-scanning horizontal sync signal in the printer
20   engine 20. The video controller 10 sends a video
(/VDO) signal corresponding to one main-scanning line
in synchronism with the trailing edge of the /BD
signal.

A ready (/RDY) signal indicates that the printer
25   engine 20 is set in a printable state by a print start
command (/PRNT signal is "true") from the video
controller 10. Conditions that make the /RDY signal

"true" are that the heat roller in the fixing unit has

an appropriate temperature (a temperature that is

sufficient for fixing a toner image on a paper sheet),

no recording paper sheets have jammed, the polygon

5   mirror normally rotates at a specific rotational speed,

and the /BD signal is normally output at a specific

period.

A top of page (/TOP) signal is a sub-scanning

print sync signal in the printer engine 20. The video

10   controller 10 sets the sub-scanning image print start

position in synchronism with the trailing edge of the

/TOP signal. In this example, the paper feed sensor is

arranged such that the time until the printing paper

sheet reaches the transfer roller after detection of

15   the leading edge of a printing paper sheet equals the

time until the latent image formed on the

photosensitive body by a laser beam reaches the

transfer roller as the photosensitive drum rotates.

For this reason, upon detecting that the paper feed

20   sensor signal (PFSNS) from the paper feed sensor has

changed to "true", the printer engine 20 immediately

sets the /TOP signal to "true" for 1 sec.

A status (/STS) signal is 16-bit serial

information transmitted from the printer engine 20 to

25   the video controller 10. This signal is called a

status.

A condition change report (/CCRT) signal notifies

the video controller 10 that a status in the printer, which is designated in advance, has changed.

With a print (/PRNT) signal, the video controller 10 commands the printer engine 20 to start the printing

5   operation. In a continuous print mode, the signal means the continuation of printing operation.

A controller power ready (/CPRDY) signal indicates that power is supplied to the video controller 10, and the video controller 10 is

10 completely initialized and is capable of transmitting/receiving a command or status to/from the printer engine 20.

The video (/VDO) signal indicates an image signal to be printed by the printer engine 20. This image

15 signal is obtained by causing the video controller 10 to convert image code data received from the host computer into dot data.

A command (/CMD) signal is 16-bit serial information transmitted from the video controller 10 to

20 the printer engine 20. This signal is called a command.

A clock (/SCLK) signal is a serial data sync clock used in transmitting the /CMD signal or /STS signal.

25 With a reset (/RESET) signal, the video controller 10 requests the printer engine 20 to initialize the printer. When this signal is LOW level

for a specific time or more, the printer engine 20

initializes the engine.

Commands from the video controller 10 to the

printer engine 20 and statuses from the printer engine

5   20 to the video controller 10, which are

transmitted/received by the above-described serial

communication, will be described next.

In 16-bit data transmitted/received by the serial

communication, the MSB is defined as the most

10   significant bit of the transmission/reception data, and

the 15th bit from the MSB is defined as the least

significant bit of the transmission/reception data.

The LSB is defined as an odd parity bit.

In the above-described data format, when a 1-word

15   (16-bit) command is issued from the video controller 10

to the printer engine 20 in synchronism with the /SCLK

signal, the printer engine 20 returns a 1-word status

to the video controller 10. This command contains a

status request command to check the status (state) of

20   the printer engine 20 and an execution command that

commands the printer engine 20 to execute a certain

operation.

In the operation for rewriting the flash ROM,

generally, rewrite data is transferred from the video

25   controller 10 to the RAM 31 of the printer engine 20 by

serial communication by using the /CMD, /STS, and /SCLK

signals. The CPU 30 of the printer engine 20 rewrites

the data in the flash ROM 32 by the data in the RAM 31
in accordance with a rewrite program.

In the prior art, however, when the flash ROM 32
should be rewritten, the program for the normal image
5   forming operation in the flash ROM 32 mounted in the
printer engine 20 is erased, and the program on the
flash ROM to be rewritten cannot be executed in the
rewrite mode. For this reason, the rewrite program
must be executed by executing a program on a ROM that
10   is not to be rewritten. Alternatively, the rewrite
program must be bitmapped and executed on the RAM 31 to
rewrite the flash ROM.

The capacity of the RAM 31 mounted in the printer
engine 20 is generally smaller than the ROM capacity.
15   For this reason, the entire rewrite program cannot be
downloaded at once to the RAM 31 to rewrite the flash
ROM. The program must be rewritten while downloading
the program to the RAM 31. Hence, a special operation
different from the normal image forming operation must
20   be performed.

The time necessary for rewriting the flash ROM 32
includes the time to transfer data to be used for the
rewrite to the RAM 31 of the printer engine 20 and the
rewrite time by the program. The time to transfer data
25   to be used for the rewrite to the printer engine 20
occupies the most part.

SUMMARY OF THE INVENTION

The present invention has been made to solve the above problems, and has as its object to shorten the data transfer time in serial communication between the controller section and the engine section of an image forming apparatus.

In order to achieve the above object, according to an aspect of the present invention, there is provided a data transfer method in an image forming apparatus which comprises a nonvolatile memory and is constituted by an engine section which forms an image and a controller section which transmits image data to the engine section, comprising steps of: establishing synchronization of data transfer by a predetermined control signal of serial communication when data should be transferred from the controller section to the engine section to rewrite the nonvolatile memory; and rewriting the nonvolatile memory by the data transferred in synchronism.

According to another aspect of the present invention, there is provided an image forming apparatus which comprises a nonvolatile memory and is constituted by an engine section which forms an image and a controller section which transmits image data to the engine section, comprising: means for establishing synchronization of data transfer by a predetermined control signal of serial communication when data should

be transferred from the controller section to the engine section to rewrite the nonvolatile memory; and means for rewriting the nonvolatile memory by the data transferred in synchronism.

5   Other features and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures

10   thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing an interface that connects a video controller 10 and printer engine

15   20 in a printing apparatus;

Fig. 2 is a table showing a list of video interface signals;

Fig. 3 is a block diagram showing the arrangement of a printing apparatus according to an embodiment;

20   Fig. 4 is a sectional view showing the structure of the printing apparatus according to the embodiment;

Fig. 5 is a flow chart showing an operation for rewriting program codes stored in a flash ROM in an engine section 320;

25   Fig. 6 is a flow chart showing data transmission processing in a controller section 310 according to the first embodiment;

Fig. 7 is a flow chart showing flash ROM rewrite processing in the engine section 320;

Fig. 8 is a timing chart showing an image forming operation and a flash ROM rewrite operation;

5   Fig. 9 is a flow chart showing flash ROM rewrite processing in an engine section 320 according to the second embodiment;

Fig. 10 is a flow chart showing error detection processing by a controller section 310; and

10   Fig. 11 is a timing chart of serial communication between the controller section 310 and the engine section 320 when the flash ROM of the engine section 320 according to the second embodiment is to be rewritten.

15

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The embodiments of the present invention will be described below in detail with reference to the accompanying drawings.

20   The sizes and layout of constituent elements and the flow charts of processing operations described in the embodiments do not limit the scope of the invention unless otherwise specified.

In the embodiments, a printing apparatus will be

25 exemplified as an image forming apparatus. However, the present invention is not limited to this and can also be applied to a copying machine or facsimile

apparatus that executes data transfer by serial

communication between a controller section and an

engine section.

Fig. 3 is a block diagram showing the arrangement

5   of a printing apparatus according to an embodiment. As

shown in Fig. 3, the printing apparatus has a

controller section 310 and an engine section 320. In

the controller section 310, a CPU 301 executes a

control program stored in a ROM 303 and receives image

10   information (code data) described in a page description

language (PDL) from an external device (host computer)

through an external interface 330. The received image

information is input to an image processing section

304. The image processing section 304 stores the image

15   information in a RAM 305 and analyzes the image

information. A RAM 302 is a memory on which a work

area and registers to be used by the CPU 301 in

executing processing are defined. A ROM 306 stores

font data corresponding to the value of the image

20   information.

The image processing section 304 reads out

corresponding font data from the ROM 306, converts the

received image information into dot video data to be

printed by the engine section 320, and stores the video

25   data in a frame memory 307. When video data of one

page is stored in the frame memory 307, the CPU 301

sends a print command to the engine section 320 through

a video interface 340. In addition, the CPU 301 sends

the video data stored in the frame memory 307 to the

engine section 320 in synchronism with the main- and

sub-scanning sync signals from the engine section 320.

5   The engine section 320 incorporates a control

section 321 constituted by a CPU or microprocessor

(MPU), a RAM, and a flash ROM, like the printer engine

shown in Fig. 1. The microprocessor controls the image

forming process in accordance with the control program

10 of the engine section, which is stored in the flash

ROM. The control program written in the flash ROM is

changed when control of the engine section 320 is

changed. The rewrite of the flash ROM will be

described later.

15   The video interface 340 that connects the

controller section 310 and engine section 320 of the

printing apparatus according to this embodiment is the

same as the interface shown in Fig. 1. Signals

exchanged between the controller section 310 and the

20 engine section 320 are also the same as those shown in

Fig. 2, and a description thereof will be omitted.

        Fig. 4 is a sectional view showing the structure

of the printing apparatus according to this embodiment.

The same reference numerals as in Fig. 3 denote parts

25 having the same functions in Fig. 4. A laser beam

printer will be described as a printing apparatus main

body 400 in this embodiment.

Referring to Fig. 4, an optical unit 401 modulates a laser beam in accordance with the video data sent through the video interface 340. A deflection mirror 402 reflects the laser beam output

5   from the optical unit 401. The laser beam reflected by the deflection mirror 402 is scanned on a photosensitive drum 403 by a rotary polygon mirror (not shown) so that an electrostatic image is formed on the photosensitive drum 403. A charger 404 uniformly

10   charges the photosensitive drum 403. A developer 405 develops the electrostatic image on the photosensitive drum 403 to a toner image.

A transfer charger 406 transfers the toner image on the photosensitive drum 403 to a printing paper

15   sheet. A cleaner 407 recovers the toner remaining on the photosensitive drum 403 after transfer. An upper paper feed roller 409a feeds a printing paper sheet stored in an upper cassette 408a. A lower paper feed roller 409b feeds a printing paper sheet stored in a

20   lower cassette 408b. Paper conveyance rollers 410 convey the fed printing paper sheet to the transfer position. A TOP sensor 411 detects the presence/absence of the fed printing paper sheet. A fixer 412 fixes the toner image transferred to the

25   printing paper sheet on the printing paper sheet by heating and pressing. A discharge sensor 413 detects the presence/absence of a paper sheet discharged from

the fixer 412. A discharge tray 414 receives the
discharged printing paper sheet.

[First Embodiment]

Procedures for rewriting control program codes
5   (to be referred to as program codes hereinafter) stored
in the flash ROM in an engine section 320 through a
video interface 340 that connects a controller section
310 and the engine section 320 in the above-described
printing apparatus will be described.

10   Fig. 5 is a flow chart showing an operation for
rewriting program codes stored in the flash ROM in the
engine section 320. First, in step S501, when a
command to rewrite the program codes in the engine
section 320 is input from a host computer through an
15   external interface 330 of the controller section 310 or
from the operation panel (not shown) of the controller
section 310, a CPU 301 in the controller section 310
sends a command that designates a program code rewrite
mode to a control section 321 of the engine section 320
20   through the video interface 340.

In step S502, when a status representing that the
program code rewrite mode is set is received from the
control section 321 of the engine section 320, the CPU
301 sends, to the control section 321, a command that
25   designates the write start address of the flash ROM in
which the program codes should actually be rewritten.
In step S503, the CPU 301 of the controller section 310

transmits the program code data transmitted from the
host computer to the control section 321 of the engine
section 320 as a command by serial communication.

Instead of transmitting the program code data
5   while designating one address in correspondence with
one program code data in the flash ROM, a predetermined
number of data are transmitted from the address
designated in step S502 described above.

In step S504, it is determined whether the
10 predetermined number of data are transmitted. If NO in
step S504, the flow returns to step S503 to transmit
program code data. The above-described operation is
repeated until the predetermined number of data are
transmitted. When it is determined that the
15 predetermined number of data are transmitted, the
program code data transmission is ended.

The above-described data transmission is done
through a serial communication path (video interface
340). A /CCRT signal is used as a signal that
20 establishes synchronization in the serial
communication. In the normal image forming operation,
the control section 321 in the engine section 320
notifies the controller section 310 by using the /CCRT
signal that the state in the engine section 320 has
25 changed. More specifically, if the /CCRT signal is OFF
(HIGH level) at the time of data transmission, the
controller section 310 determines that the engine

section 320 cannot receive data, and does not execute data transmission. If the /CCRT signal is ON (LOW level), the controller section 310 determines that the engine section 320 can receive data, and executes data

5   transmission. With this operation, synchronization of serial communication is established.

An operation will be described next, in which while the controller section 310 and engine section 320 maintain synchronization by serial communication in

10   steps S503 and S504 in Fig. 5 described above, the controller section 310 transmits flash ROM program code write data as a command, and the control section 321 in the engine section 320 rewrites the program codes in the flash ROM by the received data.

15   First, details of processing for transmitting the program code data in steps S503 and S504 after the CPU 301 in the controller section 310 designates the program code rewrite mode in step S501 shown in Fig. 5 described above and designates the program code write

20   start address in step S502 will be described. Synchronization control at the time of data transmission by the above-described /CCRT signal is the same as described above, and a description thereof will be omitted.

25   Fig. 6 is a flow chart showing data transmission processing in the controller section 310 according to the first embodiment. In step S601, the CPU 301 in the

controller section 310 transmits a flash ROM erase command to the control section 321 in the engine section 320. In step S602, the CPU 301 receives a status corresponding to the erase command from the

5 control section 321 in the engine section 320.

In step S603, the CPU 301 transmits, as a command, the data of program codes for rewriting the flash ROM. In step S604, the CPU 301 receives a status corresponding to the command. In steps S605 to S608,

10 error recovery processing is executed on the basis of error information recorded in the received status.

If transfer error information is received in step S605, the flow advances to step S606 to execute command resending processing. If the number of times of

15 transfer error information reception does not exceed a predetermined number of times of retry, the flow returns to step S603 to resend the command. If the number of times of retry exceeds the predetermined number, the processing is ended.

20 If write error information is received in step S607, the flow advances to step S608. If the number of times of reception does not exceed a predetermined number of times of retry, the flow returns to step S601 to execute processing for transmitting the write data

25 again. If the number of times of reception exceeds the predetermined number of times of retry, the processing is ended.

In step S609, it is determined whether the write data corresponding to a predetermined number of data are transmitted as commands. If NO in step S609, the flow returns to step S603 to repeat the above-described

5 processing until all data are transmitted.

Processing will be described next, in which the control section 321 in the engine section 320 rewrites the flash ROM while establishing synchronization of serial communication with respect to the controller

10 section 310 without storing, in the RAM, the program codes of the flash ROM, which are sent from the controller section 310 by serial communication.

This processing is flash ROM rewrite processing which is executed by the control section 321 in the

15 engine section 320 in correspondence with the above-described data transmission processing by the controller section 310 shown in Fig. 6 described above. The above-described /CCRT signal is ON (LOW level) in the initial state. When a command that designates the

20 program code rewrite mode is received from the controller section 310, the /CCRT signal controls reception of addresses and data while executing the above-described synchronization processing.

Fig. 7 is a flow chart showing flash ROM rewrite

25 processing in the engine section 320. In step S701, the control section 321 in the engine section 320 receives the data of program codes sent from the

controller section 310 as a command by serial

communication. In step S702, the above-described /CCRT

signal is changed to the OFF state (HIGH level) to

notify the controller section that the control section

5 is not ready for reception of the next command. In

step S703, a status is returned to the controller

section 310. In step S704, program code data erase or

write processing is executed in accordance with the

command received in step S701 described above.

10   In the first embodiment, error information of a

transfer error or write error is recorded in a status

and returned.

       In step S705, the /CCRT signal is changed to the

ON state (LOW level) to notify the controller section

15 310 that the control section 321 is ready for reception

of the next command in serial communication. It is

determined whether write data corresponding to a

predetermined number of data are received. If NO in

step S706, the flow returns to step S701 to repeat the

20 above-described processing until all data are received.

       As described above, when the /CCRT signal is used

for synchronization control, the controller section 310

can determine that the engine section 320 can reliably

receive a command. For this reason, the wait time

25 until the next serial communication can be shortened.

       Hence, the communication speed in transferring

the codes of the control program of the flash ROM can

be increased.

Fig. 8 is a timing chart showing an image forming operation and a flash ROM rewrite operation. Fig. 8 shows the timing chart of command/status
5   transmission/reception by serial communication and the /CCRT signal in the two operations. A status of the engine section 320 is returned in correspondence with a command from the controller section 310.

As shown in Fig. 8, in the normal image forming
10   operation, when the internal state of the engine section 320 changes, the above-described /CCRT signal changes to the OFF state (HIGH level). The controller section 310 that has received the /CCRT signal in the OFF state transmits a command that requests the state
15   of the engine section 320. The control section 321 in the engine section 320 records the state of the engine section 320, which corresponds to the request command, in the status and returns the status.

In the flash ROM write operation, the control
20   section 321 in the engine section 320 uses the /CCRT signal as serial communication data reception preparation completion notification signal from the controller section 310. When the /CCRT signal changes from the OFF state to the ON state, the controller
25   section 310 sends a command. The engine section 320 receives predetermined program code data as a command and writes the data in the flash ROM.

[Second Embodiment]

The second embodiment of the present invention will be described next in detail with reference to the accompanying drawings.

5   In the above-described first embodiment, the controller section 310 acquires error information of a transfer error or write error as a status from the engine section 320. In the second embodiment, the above-described /CCRT signal is used even for error

10   detection.

The arrangement of a printing apparatus according to the second embodiment is the same as that of the first embodiment shown in Figs. 3 and 4, and a description thereof will be omitted.

15   In addition, processing in steps S501 and S502 shown in Fig. 5, in which control program codes (to be referred to as program codes hereinafter) stored in the flash ROM in an engine section 320 are rewritten through a video interface 340 that connects a

20   controller section 310 and the engine section 320, is the same as in the first embodiment, and a description thereof will be omitted. Furthermore, as in the first embodiment, the /CCRT signal is used as a signal that controls synchronization of serial communication.

25   Processing as a characteristic feature of the second embodiment will be described here, in which instead of causing the engine section 320 to returning

a status in correspondence with a command transmitted

from the controller section 310 to the engine section

320, the /CCRT signal used for synchronization control

of serial communication is caused to function as error

5   information to be sent to the controller section 310.

Fig. 9 is a flow chart showing flash ROM rewrite

processing in the engine section 320. In step S901, a

control section 321 in the engine section 320 receives

the data of program codes sent from the controller

10   section 310 as a command by serial communication. In

step S902, the above-described /CCRT signal is changed

to the OFF state (HIGH level) to notify the controller

section that the data is received, and the control

section is not ready for reception of the next data.

15   In step S903, it is determined by normal parity check

whether the received command has a data error. If YES

in step S903, the flow advances to step S904. The

processing waits for a time until the controller

section 310 detects the communication error. When the

20   time has elapsed, the flow advances to step S907.

If NO in step S903, the flow advances to step

S905 to execute program code data erase or write

processing in accordance with the command received in

step S901 described above. In step S906, it is

25   determined whether an erase or write error has occurred

in step S905. If YES in step S906, the flow advances

to step S909. The processing waits for a time until

the controller section 310 detects the occurrence of
the error. When the time has elapsed, the flow
advances to step S907. If NO in step S906, the flow
advances to step S907 to change the /CCRT signal to the
5   ON state (LOW level) to notify the controller section
310 that the control section 321 is ready for reception
of the next command. It is determined in step S908
whether rewrite data corresponding to a predetermined
number of data are received. If NO in step S908, the
10   flow returns to step S901 to repeat the above-described
processing until all data are received.

As described above, when the /CCRT signal is used
as a sync signal of serial communication, the
processing for causing the engine section 320 to return
15   a status in correspondence with a command from the
controller section 310 can be omitted. For this
reason, as compared to data transfer by only normal
serial communication, the data communication amount can
be reduced, and data can be transferred at a high
20   speed.

Processing will be described next, in which when
flash ROM rewrite data is transmitted from the
controller section 310 to the engine section 320, an
error that has occurred in the engine section 320 is
25   detected by using the /CCRT signal. In the second
embodiment, in the flash ROM rewrite mode, the
controller section 310 detects whether the processing

for causing the engine section 320 to rewrite the

program is being normally executed by monitoring the

change time of the /CCRT signal.

Fig. 10 is a flow chart showing error detection

5   processing by the controller section 310. In step

S1001, a CPU 301 in the controller section transmits a

command to the control section 321 in the engine

section 320. In steps S1002 and S1003, the controller

section waits until the /CCRT signal from the control

10   section 321 in the engine section 320 changes to the ON

state (LOW level) within specified time 1. The time

necessary for the flash ROM erase/rewrite in the engine

section 320 is specified by each flash ROM. The

specified time 1 is the sum of the time necessary for

15   data transmission/reception and the minimum time

necessary for the flash ROM erase/rewrite operation in

the flash ROM erase/rewrite mode.

When the control section 321 in the engine

section 320 changes the /CCRT signal to the ON state

20   within the specified time 1, the controller section 310

determines that a data error has occurred in command

transmission. The flow returns to step S1001 to

retransmit the same command. If the /CCRT signal does

not change to the ON state even when the specified time

25   1 has elapsed in step S1003, the flow advances to step

S1004. In steps S1004 and S1005, the controller

section waits until the /CCRT signal changes to the ON

- 23 -

state within specified time 2 that is the maximum wait

time for monitoring the change of the /CCRT signal. If

the /CCRT signal does not change to the ON state even

when the specified time 2 has elapsed, it is determined

5   that the control of the engine section 320 is not

correctly executed, and the processing is ended.

If the /CCRT signal changes to the ON state

within the specified time 2 in step S1005, the flow

advances to step S1006 to check whether specified time

10   3 which is the sum of the time necessary for data

transmission/reception and the maximum time necessary

for the flash ROM erase/rewrite operation has not

elapsed yet. If the specified time 3 has elapsed, it

is determined in the flash ROM erase/write operation

15   that the flash ROM erase/write has failed or in the

operation for receiving a control command, data, or

address that a data error has occurred in command

transmission. The flow returns to step S1001 to

retransmit the same command. If the specified time 3

20   has not elapsed yet, it is determined that data

transfer and command processing have normally ended.

The flow advances to step S1007 to check whether all

commands are transmitted. If NO in step S1007, the

flow returns to step S1001 to repeat the

25   above-described processing for transmitting the next

command.

As described above, the controller section 310

can detect a data communication error or data

processing error that has occurred in the engine

section 320 by using the /CCRT signal.

The specified time in which the controller

5   section 310 monitors the /CCRT signal may be changed

depending on the size of data to be written in the

flash ROM, the size of the block to be erased, or

whether transfer of rewrite data is progressing.

Fig. 11 is a timing chart of serial communication

10   between the controller section 310 and the engine

section 320 when the flash ROM of the engine section

320 according to the second embodiment is to be

rewritten.

As described above, according to the embodiment,

15   when program code data is transferred from the

controller section 310 to the engine section 320 to

rewrite the flash ROM (nonvolatile memory) of the

control section 321 in the engine section 320,

processing related to rewrite data transfer in serial

20   communication can be simplified, and the rewrite of the

nonvolatile memory can be executed at a high speed.

[Other Embodiment]

The present invention may be applied to a system

constituted by a plurality of devices (e.g., a host

25   computer, an interface device, a reader, a printer, and

the like) or an apparatus comprising a single device

(e.g., a copying machine, a facsimile apparatus, or the

like).

The object of the present invention is achieved even by supplying a recording medium which records software program codes for implementing the functions of the above-described embodiments to the system or apparatus and causing the computer (or a CPU or MPU) of the system or apparatus to read out and execute the program codes stored in the recording medium.

In this case, the program codes read out from the recording medium implement the functions of the above-described embodiments by themselves, and the recording medium which stores the program codes constitutes the present invention.

As the recording medium for supplying the program codes, for example, a floppy disk (registered trademark), hard disk, optical disk, magnetooptical disk, CD-ROM, CD-R, magnetic tape, nonvolatile memory card, ROM, or the like can be used.

The functions of the above-described embodiments are implemented not only when the readout program codes are executed by the computer but also when the operating system (OS) running on the computer performs part or all of actual processing on the basis of the instructions of the program codes.

The functions of the above-described embodiments are also implemented when the program codes read out from the recording medium are written in the memory of

a function expansion board inserted into the computer

or a function expansion unit connected to the computer,

and the CPU of the function expansion board or function

expansion unit performs part or all of actual

5   processing on the basis of the instructions of the

program codes.

As described above, according to the embodiments,

the data transfer time in serial communication between

the controller section and the engine section of the

10   image forming apparatus can be shortened.

The present invention is not limited to the above

embodiments and various changes and modifications can

be made within the spirit and scope of the present

invention. Therefore, to apprise the public of the

15   scope of the present invention, the following claims

are made.